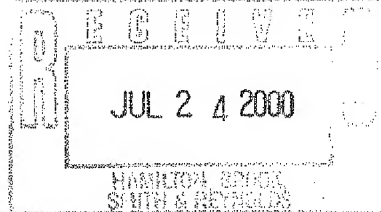


# PATENT COOPERATION TREATY



From the  
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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## PCT

NOTIFICATION OF TRANSMITTAL OF  
THE INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT  
(PCT Rule 71.1)

Date of mailing  
(day/month/year)

13.07.2000

RECEIVED

Applicant's or agent's file reference

AVI98-01pA

2390.1006-003

JUL 24 2000  
IMPORTANT NOTIFICATION

International application No.  
PCT/US99/08334

International filing date (day/month/year)  
15/04/1999

Priority date (day/month/year)  
24/04/1998

INTERNATIONAL  
FILING DEPT.

Applicant

AVICI SYSTEMS

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.

FOREIGN DOCKETING

☒ Initial

3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

ANNUITY DOCKETING

☐

#### 4. REMINDER

ANR \_\_\_\_\_ AND \_\_\_\_\_

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/

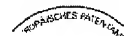


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# PATENT COOPERATION TREATY

## PCT

### INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference <b>AVI98-01pA</b>	<b>FOR FURTHER ACTION</b>		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. <b>PCT/US99/08334</b>	International filing date ( <i>day/month/year</i> ) <b>15/04/1999</b>	Priority date ( <i>day/month/year</i> ) <b>24/04/1998</b>	
International Patent Classification (IPC) or national classification and IPC <b>H04L12/00</b>			
Applicant <b>AVICI SYSTEMS</b>			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 10 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 5 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☒ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☒ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand  <b>29/10/1999</b>	Date of completion of this report  <b>13.07.2000</b>
Name and mailing address of the international preliminary examining authority:   <b>European Patent Office</b> <b>D-80298 Munich</b> <b>Tel. +49 89 2399 - 0 Tx: 523656 epmu d</b> <b>Fax: +49 89 2399 - 4465</b>	Authorized officer  <b>Kesting, V</b>  Telephone No. +49 89 2399 7434 <div style="text-align: right;">  </div>

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/US99/08334

**I. Basis of the report**

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

**Description, pages:**

1-10 as originally filed

**Claims, No.:**

1-36 with telefax of 02/05/2000

**Drawings, sheets:**

1/5-5/5 as originally filed

2. The amendments have resulted in the cancellation of:

- ☐ the description, pages:  
☐ the claims, Nos.:  
☐ the drawings, sheets:

3. ☒ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

**see separate sheet**

4. Additional observations, if necessary:

**II. Priority**

1. ☐ This report has been established as if no priority had been claimed due to the failure to furnish within the prescribed time limit the requested:
- ☐ copy of the earlier application whose priority has been claimed.
- ☐ translation of the earlier application whose priority has been claimed.
2. ☐ This report has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid.

# INTERNATIONAL PRELIMINARY EXAMINATION REPORT

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Thus for the purposes of this report, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

**see separate sheet**

**V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. Statement

Novelty (N)	Yes:	Claims	1-36
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-36
Industrial applicability (IA)	Yes:	Claims	1-36
	No:	Claims	

2. Citations and explanations

**see separate sheet**

**VI. Certain documents cited**

1. Certain published documents (Rule 70.10)

and / or

2. Non-written disclosures (Rule 70.9)

**see separate sheet**

**VII. Certain defects in the international application**

The following defects in the form or contents of the international application have been noted:

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT**

International application No. PCT/US99/08334

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**VIII. Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**see separate sheet**

**INTERNATIONAL PRELIMINARY  
EXAMINATION REPORT - SEPARATE SHEET**

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**Re Item I**

**Basis of the report**

The amendments filed with facsimile of 02.05.2000 contain subject-matter which extends beyond the contents of the application as originally filed. The amendment concerned is the following:

**Claim 20** specifies that a destination of the packet is identified **at an input to a routing fabric**. This is not disclosed in the application as originally filed. Instead, the application as originally filed discloses that **the router** identifies the destination (page 4, lines 2 - 3). Other related passages are silent with respect to **where** the destination is identified (page 8, lines 5 - 6; page 8, last line - page 9, line 2; Fig. 7 and 8); rather they give an indication as to **when** the identification takes place. Hence, it is not directly and unambiguously derivable from the application as originally filed that the destination of the packet is identified at an input to a routing fabric.

This report has therefore been established as if the addition of the phrase "at an input to a routing fabric" had not been made in claim 20.

**Re Item II**

**Priority**

The following document is not comprised in the state of the art relevant to the present application:

Publication number: **EP-A-0 863 646** *Handel et al.*  
Publication date: 09.09.1998  
Filing date: 05.03.1998  
Priority date: 07.03.1997

However if it were determined that the priority of the present application should be declared invalid, then the above-cited document could become relevant for the evaluation of the aspects relating to inventive step.

**Re Item V**

**Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. The subject-matter of **claim 20** (see section I) which has the broadest scope is not inventive, Article 33(3), over **D1 = US-A-5 546 379**.
  - 1.1 D1 discloses a method of routing a packet in a network (abstract; column 11, line 62) comprising routers (column 9, line 50; column 10, line 32/33) which in order to route a packet identify its destination. The method comprises the steps of selecting one of a plurality of trunks forming a composite trunks to the destination (column 4, lines 24 - 25; column 5, lines 11 - 18; paragraph bridging columns 5 and 6; column 6, lines 36 - 46; Fig. 4, command line "set deviceToUse <- D"; Fig. 5, box "selection means"), and forwarding the packet toward the destination on the selected trunk (column 2, line 15; Fig. 4, last line; column 15, lines 59 - 61).
  - 1.2 The difference between the subject-matter of claim 20 and this known method is that the packet is forwarded through a routing fabric comprising a plurality of nodes.
  - 1.3 It is, however, a common measure in the art of routers to use multi-node routing fabrics for internally forwarding packets from an input port to an output port of a router, in particular when many trunks are involved and a high throughput is to be achieved. Hence, from the starting point of D1, the skilled person would arrive at the subject-matter of claim 1 without performing an inventive step.
  - 1.4 It is noted that documents **D2 = 'Multilink PPP: One Big Virtual WAN Pipe' by G.E. Conant [Data Communications, US, McGraw Hill, New York, vol. 24, no. 13, 21 September 1995 (1995-09-21), page 85-88,90, ISSN: 0363-6399]** (Fig. 2; page 85, second column, paragraph "Big protocol tent"; page 85, third column, lines 7 - 10; page 87, third column, lines 2 - 5; page 88, third column, last paragraph) and **D3 = EP-A-0 649 098** (abstract; claim 1; column 4, lines 12 - 17; column 9, lines 16 - 19; column 1, lines 48 - 53; column 12, lines 20 - 29; column 12, lines 30 - 33) also disclose routing methods based on the same principle of selecting a trunk within a composite trunk.

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2. Apparatus **claim 1** corresponds to method claim 20 and in addition specifies that a composite port includes ports from a plurality of nodes and that a path between ports involves multiple hops. The latter is a mere consequence of the fact that the routing fabric comprises a plurality of nodes (and is therefore a network in itself); the former is a common measure because in order to fully realise the potential advantages of composite trunking (e.g. high bandwidth; simplification of routing tables) the skilled person would obviously not restrict the definition of a composite port to only one single node in the routing fabric, but would of course define it as comprising a plurality of ports, corresponding in turn to a plurality of nodes of the routing fabric.

Therefore, claim 1 also does not fulfill the requirement of inventive step, Article 33(3).

3. The additional features of the **dependent claims 2 - 19 and 21 - 36** are either also known from the prior art (load balancing, claims 4, 5, 14, 15, 23, 24, 31, 32; look-up table, claims 7, 26; Internet and IP, claims 12, 35) or are common measures (flow integrity, claims 2, 3, 10, 11, 19, 21, 22, 29, 30; distance minimization, claims 6, 16, 25, 33; mapping alternatives, claims 8, 9, 17, 18, 27, 28; routing fabric topology, claims 13, 36; final destination identifier, claim 34). These claims thus also fail to meet the requirement of inventive step, Article 33(3).

**Re Item VI**

**Certain documents cited**

The following document is cited according to Rule 70.10:

Patent No.:	<b>EP-A-0 910 195</b>
Publication date:	21.04.1999
Filing date:	17.09.199
Priority date:	23.09.1997



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**Re Item VII**

**Certain defects in the international application**

1. Documents D1 - D3 are not acknowledged in the description, Rule 5.1(a)(ii).
2. The description is not adapted to the wording of the claims, Rule 5.1(a)(iii).
3. The two-part form, Rule 6.3(b), is not used for the independent claims, with a pre-characterising part that correctly reflects the closest prior art (D1).
4. The passages "which is incorporated herein by reference in its entirety" (page 6, lines 15 - 16) and "which is incorporated herein by reference" (page 7, line 10) do not comply with the requirement of a self-contained application, cf. Guidelines II, 4.17.
5. The words "spirit and" (last paragraph on page 10), try to expand the extent of protection in a vague and imprecisely defined way, cf. Guidelines III, 4.3a. The same is noted with respect to the last sentence of the same paragraph.

**Re Item VIII**

**Certain observations on the international application**

The following is noted with respect to the requirements of conciseness and clarity, Article 6:

1. In **claim 1** it is not clear what the grammatical link is between the parts "path between ports [...] of the fabric" and "a composite port including ports from plural nodes" on the one hand, and the remaining parts of the claim on the other.
2. In **claim 20** the meaning of the phrase "from plural nodes of the routing fabric" is not clear, i.e. the technical features associated with it in the context of the remaining words of the claim are not clear.

It is noted that the selection of a trunk from a plurality of nodes is meaningless

because such a selection of a trunk is possible only from a plurality of trunks. It is also noted that there is no evidence in the remaining words of the claim in the light of which the phrase could be understood. Hence, the relation between the plural nodes on the one hand and the trunks and the composite trunk on the other remains obscure and, as a consequence, the very purpose of the former within the claimed method is not clear.

3. Dependent **claims 2, 10 and 19** specify identical features. As a consequence, redundancy is contained in the claims which therefore lack conciseness. These three claims should be replaced by a single claim comprising appropriate references to the claims they depend on.

The same is noted with respect to the following groups of claims: {**3,11**}, {**4,14**}, {**5,15**}, {**6,16**}, {**23,31**}, {**24,32**}, {**25,33**}.

4. Although directed to apparatus, **claims 1 - 7, 10, 11, 14 - 16 and 19** contain method features ("selects", "maintains", "balances", "favors", "determines"), whereby doubt is cast as to the category of the claims.

5. **Claim 29** defines its subject-matter by a result to be obtained, cf. Guidelines, III, 4.7.

6. The following terms are ambiguous and therefore not clear:

- a composite port (**claim 1**, lines 8 on page 11; is this the composite port previously specified in line 4, or a different one?);
- plural nodes (**claim 1**, lines 8 on page 11; are these the plural nodes previously specified in line 6, or different ones?);
- a flow (**claim 11**; is this the flow of claim 10 or a different one? A similar comments applies to **claim 30** as referring back to claim 29);
- a forwarding table (**claim 18**; is this the same forwarding table as the one specified in claim 17, or a different one?);
- order of packets (**claim 22**; are these packets the same packets as those specified in claim 21, or different ones? A similar comments applies to **claim 30**).

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7. The term "packets" (plural form) in **claim 35** lacks an antecedent and is therefore not clear (note also that in claim 36, which depends on claim 35, the singular is used again).

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## CLAIMS

What is claimed is:

1. A network router comprising:
  - a plurality of trunk ports, including a composite port of plural ports to plural trunks which serve as a composite trunk to a common destination;
  - a routing fabric of plural nodes for transfer of data packets between trunk ports at respective nodes, paths between ports including multiple hops through nodes of the fabric, a composite port including ports from plural nodes; and
  - an output port selector at each input node which selects an output port for a packet from a composite port.
2. The router as claimed in Claim 1 wherein the output port selector maintains ordering of packets within a flow by routing the packets of the flow on a single trunk of a composite trunk.
3. The router as claimed in Claim 2 wherein the output port selector further maintains ordering of packets within the flow by routing the packets of the flow along a single route through the router fabric.
4. The router as claimed in Claim 1 wherein the output port selector balances load across the trunks of a composite trunk.
5. The router as claimed in Claim 1 wherein the output port selector dynamically balances load across the trunks of a composite trunk.

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6. The router as claimed in Claim 1 wherein the output port selector favors output ports having lesser distances to be traversed on the routing fabric from an input port.
- 5 7. The router as claimed in Claim 1 wherein the output port selector determines the output port within the composite port by table lookup.
8. The router as claimed in Claim 1 wherein the output port selector comprises a routing table which maps destination addresses to composite trunks.
9. The router as claimed in Claim 8 wherein the output port selector further comprises a forwarding table which maps composite trunks to sets of routes  
10 within the routing fabric.
10. The router as claimed in Claim 9 wherein the output port selector maintains ordering of packets within a flow by routing the packets of the flow on a single trunk of a composite trunk.
11. The router as claimed in Claim 10 wherein the output port selector further  
15 maintains ordering of packets within a flow by routing the packets of the flow along a single route through the router fabric.
12. The router as claimed in Claim 10 wherein the network is the Internet and the destination addresses are Internet protocol addresses.
13. The router as claimed in Claim 12 wherein the routing fabric is a three-  
20 dimensional torus.

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14. The router as claimed in Claim 9 wherein the output port selector balances load across the trunks of a composite trunk.
15. The router as claimed in Claim 9 wherein the output port selector dynamically balances load across the trunks of a composite trunk.
- 5 16. The router as claimed in Claim 9 wherein the output port selector favors output ports having lesser distances to be traversed on the routing fabric from an input port.
- 10 17. The router as claimed in Claim 8 wherein the output port selector further comprises a forwarding table which maps composite trunks to sets of output ports.
18. The router as claimed in Claim 17 wherein the output port selector further comprises a forwarding table which maps output ports to sets of routes within the routing fabric.
- 15 19. The router as claimed in Claim 17 wherein the output port selector maintains ordering of packets within a flow by routing packets of the flow on a single trunk of a composite trunk.
- 20 20. A method of routing a packet in a network comprising:
  - at an input to a routing fabric, identifying a destination of the packet;
  - selecting one of plural trunks, from plural nodes of the routing fabric,
  - 20 forming a composite trunk to the destination; and
  - forwarding the packet through the routing fabric and toward the destination on the selected trunk.

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- 21. The method as claimed in Claim 20 wherein the trunk is selected to maintain ordering of packets within a flow by routing the packets of the flow on a single trunk of the composite trunk.
- 5 22. The method as claimed in Claim 21 wherein routing within the routing fabric is selected to maintain order of packets within the flow by routing the packets of the flow along a single route.
- 23. The method as claimed in Claim 20 wherein the trunk is selected to balance load across the trunks of the composite trunk.
- 10 24. The method as claimed in Claim 20 wherein the trunk is selected to dynamically balance load across the trunks of the composite trunk.
- 25. The method as claimed in Claim 20 wherein the trunk is selected to favor a lesser distance between input and output ports on the routing fabric.
- 26. The method as claimed in Claim 20 wherein the trunk is selected by table lookup.
- 15 27. The method as claimed in Claim 20 wherein the step of selecting one of plural trunks includes the step of determining the composite trunk from a destination address through routing table lookup.
- 28. The method as claimed in Claim 27 wherein the step of selecting one of plural trunks further comprises selecting a route within the routing fabric through a forwarding table lookup.
- 20 29. The method as claimed in Claim 28 wherein the route within the fabric is selected to preserve the order of packets within a flow.

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30. The method as claimed in Claim 29 wherein the route within the routing fabric is selected to maintain order of packets within a flow by routing the packets of the flow along a single route.
31. The method as claimed in Claim 28 wherein the trunk is selected to balance load  
5 across the trunks of the composite trunk.
32. The method as claimed in Claim 28 wherein the trunk is selected to dynamically balance load across the trunks of the composite trunk.
33. The method as claimed in Claim 28 wherein the trunk is selected to favor a lesser distance between input and output ports on the routing fabric.
- 10 34. The method as claimed in Claim 20 wherein the destination is identified from a final destination identifier included in the packet.
35. The method as claimed in Claim 34 wherein the network is the Internet and the packets are routed under an Internet protocol.
- 15 36. The method as claimed in Claim 35 wherein the packet is routed within the routing fabric on a three-dimensional torus fabric from an input port to an output port.